MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Article Review

Received: 29/06/2022 **Accepted:** 13/07/2022 **Published:** 01/09/2022

ANALYTICAL DETECTION OF HEAVY METALS IN COSMETIC

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Abstract

Cosmetics and so-called care products, whether skin or hair, are used by millions of people. Skin is the first line of defense in the human body, but in spite of this, some toxic elements in cosmetics may be able to cross and penetrate this barrier, causing serious dangers, including various types of cancer. while the knowledge of many users of these products risks is limited and should be improved. Some cosmetics contain concentrations of heavy elements exceeding the minimum limits set by the World Health WHO and FDA Organization
The aim of this work is review of the analytical methods that tracked the concentrations of heavy metals such as Pb, Cd, Hg and as in cosmetics of different grades.

Keywords: Heavy Metals, Cosmetic.

http://dx.doi.org/10.47832/2717-8234.12.11

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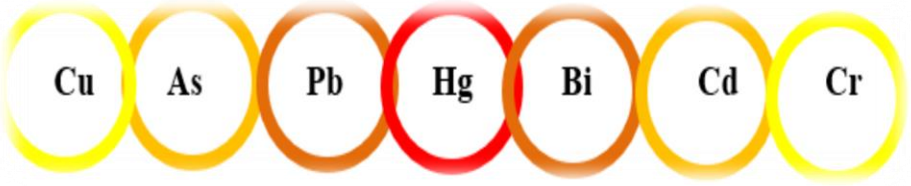
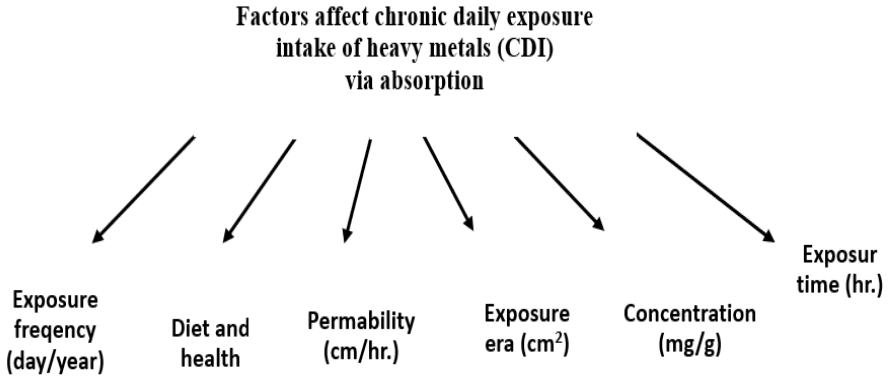
Introduction



The most toxic heavy metals in cosmetics

1.Risks of products care and cosmetics

The risks of cosmetics depend on its content level of heavy metals, its synthesis, its ability to penetrate, the exposure area of skin, the exposure time and the daily or weekly used ranges, risks of heavy metals in cosmetics are also related to the health and diet of the human (women, men, and children), as well as on the economic levels of the countries. Statistics follow up indicate a steady increase in the number of women and even men use cosmetics, as well as increasing range to include small age groups that may reach childhood, this makes the risk increases without caring to the accumulation effect of these elements in the body [1]. chronic daily exposure intake of heavy metals via absorption (CDI dermal) were found for adult in the sequence of: mercury > lead > cadmium and it can be estimated to fined cancer risk slope which is also affected by overusing, penetration ability, and long-term health problems of users [1].


Factors affect chronic daily exposure intake of heavy metals (CDI) via absorption
Exposure freqency (day/year)
Diet and health
Permability (cm/hr.)
Exposure era (cm²)
Concentration (mg/g)
Exposur time (hr.)

Recent studies on the most widely used cosmetics indicate that only 33% of them contain lead at level that fall within the ranges set by the World Health Organizations, and only 44% of them contain cadmium less than the FDA limit (3 µg/g) while 100% of the especially eye pencil samples had Cd higher than the acceptable value. The permissible level of heavy metals is strict by many heath world organizations [2]. There is compliance with laws in some countries, over 99% of the cosmetic lip products in U.S. market contain low pb level, traditional popular eyeliners, eye shadows, blushes, shampoos, and body lotions contain high levels of lead, cadmium, arsenic, mercury and antimony which are as toxic and cause in chronic effects, while chromium, Nikal, cobalt are skin sensitizers. The accumulation of these elements in human body causes many chronic deses, as reproductive disorder, neurological, brittle hair and loss as well as cancer [3].

2. Analytical methods for determination of heavy elements in care products and in cosmetic

The main techniques used for analytical detection of heavy metals are:

- Atomic absorption
- Coupled plasma-atomic emission spectroscopy (ICP-OES)
- Flame emission spectrophotometer
- Inductively coupled plasma –mass spectrometry (ICP-MS)

While the main digestion procedures use concentrated acid or mixtures of concentrated acids associated by water bath heating, sand bath heating, or digestion by microwave [2][4].

The content of Pb, Cd, Hg and As in cosmetics after wet digestion was followed by atomic absorption analysis. The calculated range of mean concentrations Pb, Cd, Hg and As scale in the cosmetic samples was between (5.93 to 22.57), (0.12 to 1.11), (30.00 to 90.32), and (0.11 to 1.0 mg/kg) respectively, These levels exceeds the permissible level of WHO [4].

Samples of many brands and colors of lipstick and eye pencil were estimated by inductively coupled plasma-atomic emission spectroscopy (ICP-OES).After the comparison of the observed data with that of FDA data ,it is found that Pb and Cd content (41.86 and 53.42 µg/g respectively) was high harmful levels [2] .In other related study a sequential atomic absorption spectrometer (SAAFS 240) has been used to follow the concentrations of lead in kohl samples and concludes a wide differences in lead content of samples level from 0.01 to 973.8 mg/g [5] .

Metallic contents (Cu, Fe and Ni) of lipstick, and whitening cream of verity brands and colors were analyzed using atomic absorption spectrophotometer (F-AAS). The concentration of Fe and Ni were higher than the allowed scall in the mentioned brands, iron only was low in lipstick and within the scale in whitening creams [6].

A certain brands of solid lipsticks ich have been analyzed for Cd and Pb content by flame emission spectrophotometer, and found that the content of lead as an average in 95.91% of selected products of Chinese lipsticks was too higher than 20 $\mu g.g^{-1}$ and all of the selected Iranian lipsticks were lower than 10 µg/g. The observed results show the relation between the intensity of the color with the element content in which the highest concentration of lead is involved in pink color and the lowest lead content is involved in violet, the highest cadmium level is present in brown lipsticks and the lowest level was detected in orange [7].

Ten of each product face powder, lipsticks, and skin lightening creams were determined using atomic absorption spectrophotometer for manganese, nickel, copper, cadmium and lead content. The results exhibits that the higher observed level was of copper in Skin lightening creams product. The method has been validated by T test [8].

Lead and cadmium in four types of solid lipstick were determined. Samples was grinded, destructed by nitric acid and perchloric acid in the ratio of (3:1), then sodium hydroxide was added to liberate ammonia, followed by filtration and diluted to 25 ml volumetric flask. The contamination of lead was not observed using atomic absorption spectrophotometry while the contamination of cadmium in lipstick of the four brands were 0.2287, 0.2000, 0.1796 and 0.1220 mg/kg [9].

A graphite furnace atomic absorption spectrometry has been used to analyze lead in lipstick after treatment with tetra methyl ammonium hydroxide. The optimum temperature of pyrolysis was 900°C and the optimum temperature of atomization was1800 °C, the linear range was 1.73 to 50.0 µg /L with LOD and LOQ limits of 0.20 and 0.34 µg /g, respectively, the precision is acceptable (RSD%: 2.37- 4.61), and recovery was between 96.2% to 109% [10].

The content of cadmium, arsenic and lead lip products, eyeliner, eyeshadow and foundation stores in Anbar /Iraq was estimated using flame atomic absorption spectrometry.

The study shows that the content of lead was lower than the allowed values according to a health Canada organization and ranged as 3.16-9.47, 1.05, 9.47, 3.16 – 8.00 and 6.84-9.68 $\mu g.g^{-1}$ in the lipstick, foundation eyeshadow respectively, While the arsenic exhibits higher content level [11].

Contamination by cadmium and lead and were determined in face soap, viz soap, shampoo, face cream, and shaving cream of certain marker by atomic absorption spectrophotometer. The study shows highest content of both elements in bathing soap [12].

Graphite furnaces atomic absorption spectrometry. The efficiency of the analysis has been compared to digestion step in the presence and absence of hydrofluoric acid by inductively coupled plasma - mass spectrometry detection. Effect of many parameters has been studied from digestion, atomic analysis conditions, and Mass detection, which exhibits law level of lead content in lipstick and out of contamination risk [13].

Digestion by microwave and analysis using inductively coupled plasma –mass spectrometry (ICP-MS) of lipsticks content of lead has been reported, the method involves a digestion by nitic acid followed by recovery of lead from oil product. Commercial lipsticks of different sources and other raw materials were digested by hydrofluoric acid (HF), in the presence of excess boric acid (H_3BO_3). The detection limit was 0.04 µg Pb per gram of sample. The average value involved of lead was 1.07 µg/g in the selected lipsticks. Some lipstick component did not digest when only HNO_3 used. A comparison of the U.S. Food and drug Administration (FDA) of lead content exhibits high level used by manufacturer to increase the color appearance [14].

The determination of heavy metals contents of frequently used cosmetics in Nigeria show that highest use of cosmetic is among 21-to-25-year age within the hall range age from 16 to55 years old. While about six percentage used it for bleaching, 21.3% of them had many adverse effects refer to Cr, Ni, Cd, and Cr high levels on eyeliner (12.7ppm) (allowed level 1ppm). Pb levels in eyeliner (87.8 ppm) and in hair –dye (21.6 ppm) was (allowed level 10 ppm). Cd levels in eyeliner (0.8 ppm), lip – gloss (0.5 ppm) and face – powder (1.8 ppm) (allowed level 0.3 ppm) [15].

Conclusion

• The use of cosmetics for a long -time may lead to damage of human health due to the presence of certain harmful substances

• Regular selection of the cosmetics increases the risks of it.

• The accumulation effect of these elements in the body, increase the risks of toxicity and cancer slope factor

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